February 11, 1892.

Mr. JOHN EVANS, D.C.L., LL.D., Treasurer, in the Chair.

The Chairman read the following Letter:—

Whitehall,
5th February, 1892.

SIR,

I have had the honour to lay before the Queen the loyal and dutiful Address of the Fellows of the Royal Society of London on the occasion of the death of His Royal Highness The Duke of Clarence and Avondale, K.G., and I have to inform you that Her Majesty was pleased to receive the Address very graciously.

I have the honour to be,
Sir,
Your obedient Servant,
HENRY MATTHEWS.

The Treasurer and Vice-President of the Royal Society of London.

A List of the Presents received was laid on the table, and thanks ordered for them.

The following Papers were read:—

I. "Note on the Spectrum of Nova Aurigæ." By J. NORMAN LOCKYER, F.R.S. Received February 8, 1892.

Since the observations of Wednesday (Feb. 3), recorded in a preliminary note, the weather precluded any further work till last night (Feb. 7). Two more photographs were taken and eye observations made.

The photographs, though exposed for a shorter time, gave many more lines than the long-exposed one on Wednesday.

The bright lines at K, H, *h*, and G are accompanied by dark lines on their more refrangible sides.

Addendum. Received February 11.

Eye Observations.

On account of continued bad weather, no further photographs or observations of the Nova have been obtained since February 7. It

then appeared to be slightly brighter than on February 3, when the star was first observed at Kensington. With the 10-inch refractor and Maclean spectroscope, C was seen to be very brilliant, and there were four very conspicuous lines in the green. Several fainter lines were also seen, and a dark line was suspected in the orange. I noticed that some of the lines, especially the bright one near F, on the less refrangible side, appeared to change rapidly in relative brightness, and this was confirmed by Mr. Fowler.

Observations of the spectrum were made by Mr. Fowler with the 3-foot reflector and the Hilger 3-prism spectroscope. Of the four most conspicuous lines in the green, F is the most refrangible, and comparisons with burning magnesium showed one of them to be sensibly coincident with the edge of the magnesium fluting at 500·6. The least refrangible of the four bright green lines was found to be slightly less refrangible than the carbon fluting near λ 517; it gives no indications of a fluted character, and further observations seemed to suggest that it was magnesium *b*, unless there be a very great change of position due to motion in the line of sight. The fourth line, which lies between F and 500·6, is about one-third of the distance between them from F, and its wave-length, assuming the star to be at rest, was estimated to be about 490.

In addition to these, the G line of hydrogen was distinctly visible, and also a group of lines between G and F. The latter were not measured, as they appear on the photographs.

Amongst the fainter lines, one was estimated to be near λ 527, and is probably the iron line at E. By comparison with the spectrum of manganese chloride burning in a spirit-lamp flame, another line was found to be sensibly coincident with the edge of the brightest fluting, λ 557·6.

There was a bright line a little more refrangible than C, and the D line was faintly visible.

Photographs.

The first photograph was exposed from 10.20 to 11.50 P.M., and the second from 12 to 2 A.M., Feb. 7, the 6-inch object-glass and prism being employed in each case. The same number of lines is shown in both photographs, the sky not being so clear during the second as during the first exposure. Twenty bright lines have been measured, and their wave-lengths are given in the accompanying table.

The table also shows probable coincidences with the lines in the spectra of the Wolf-Rayet stars, as photographed by Professor Pickering; dark lines in the Orion stars, photographed at Kensington; and bright lines in the Orion nebula, photographed at Westgate. This part of the subject will be discussed in a subsequent paper.

Lines in the spectrum of Nova Aurigæ.				Bright-line stars.	Orion stars (dark lines).	Nebula in Orion (bright lines).
1st photo.	2nd photo.	3rd photo.	3rd photo.			
Date, Feb. 3.	Date, Feb. 3.	Date, Feb. 7.	By direct comparison with α Cygni.			
By curve.	By curve.	By curve.				
K 3933	3933	3933	3933	—	3933	3933
H 3968	3968	3968	3968	3970	3968	3968
h 4101	4101	4101	4101	4101	4101	4101
4128	4130	4127	4128	—	4130	4130
4172	4172	4172	4172	—	4172	—
—	—	—	4202	4200	—	4200
4226	4227	4228	4226	—	—	42 6
4268	4268	—	4264	—	4268	4268
—	—	4294	4291	—	—	—
4312	4310	4310	4310	—	—	—
G 4340	4340	4340	4340	4340	4340	4340
—	—	—	4383	—	—	4383
—	—	—	4412	—	4415	4410
—	—	—	4434	—	—	—
—	—	—	4469	4472	4472	4472
4516	4516	4522	4518	4510	—	—
4552	4552	4554	4555	4550	—	—
4587	4587	4584	4587	—	—	—
4618	4618	4625	4625	4620	—	—
—	—	4860	F 4860	4860	4860	4860

In addition to the lines recorded in the table, the photographs of the spectrum of the Nova showed several lines more refrangible than K. These have not yet been reduced, but they probably include some of the ultra-violet hydrogen lines.

All the lines in the spectrum of the Nova are broad, although in a photograph of the spectrum of Arcturus, taken with the same instrumental conditions, the lines are perfectly sharp. It is important to note that the broadening of the lines is not accompanied by any falling off of intensity at the edges, as in the case of the hydrogen lines in such a star as Sirius. With the method employed in taking the photographs, long exposures are liable to result in a thickening of all the lines, on account of atmospheric tremors. The lines would also be thick if the Nova be hazy, as observed at Greenwich. In the photographs, however, all the lines are not equally thick.

If the lines are similarly broadened when a slit spectroscope is employed, the effect must be due to internal agitations; for if different regions of the Nova are moving with varying velocity, or with the same velocity in different directions, a normally fine line might be widened, as observed in the photographs.

The hydrogen lines and the K line of calcium are very bright, and, as pointed out in the note above, they are accompanied by dark lines on their more refrangible sides. This was previously noticed in the photographs taken on February 3, but as the dark lines were not very conspicuous, they were not referred to until further confirmation had been obtained.

It appears from a note in the 'Standard' newspaper, February 10, that dark lines have also been observed on the more refrangible sides of the bright hydrogen lines in the photographs taken at Harvard College Observatory.

A somewhat similar phenomenon has already been recorded by Professor Pickering, in the case of β Lyræ, and this has been confirmed by a series of photographs taken at Kensington. In this case, the bright lines are alternately more and less refrangible than the dark ones, with a period probably corresponding to the known period of variation in the light of the star. The maximum relative velocity indicated is stated by Professor Pickering as approximately 300 English miles per second.

In the case of Nova Aurigæ, the dark lines in all four photographs taken at Kensington are more refrangible than the bright ones, so that as yet there is no evidence of revolution. The relative velocity indicated by the displacement of the dark lines with respect to the bright ones appears to be over, rather than under, 500 miles per second. The reduction is not yet complete.

Should the photographs which may be obtained in the future continue to show the dark lines displaced to the more refrangible side of

the bright ones, it will be a valuable confirmation of my hypothesis as to the causes which produce a new star, namely, the collision of two meteor swarms. On this supposition, the spectrum of Nova Aurigæ would suggest that a dense swarm is moving towards the earth with a great velocity, and passing through a sparser swarm, which is receding. The great agitation set up in the dense swarm would produce the dark line spectrum, while the sparser swarm would give the bright lines.

In taking the first photograph, I was assisted by Mr. Fowler; the second was taken by Messrs. Fowler and Shackleton. Mr. Baxandall is responsible for the determination of the wave-lengths of the lines, and Mr. Shackleton for the determination of relative velocity.

II. "Contributions to the Physiology and Pathology of the Mammalian Heart." (From the Cambridge Pathological Laboratory.) By C. S. Roy, M.D., F.R.S., Professor of Pathology, and J. G. Adami, M.A., M.B., Fellow of Jesus College, Cambridge. Received December 31, 1891.

(Abstract.)

Our communication begins by stating that we have sought to study the action of the Mammalian heart in conditions (unexcised and intact) as nearly approaching the normal as we were able to make compatible with the employment of exact methods of research. This is followed by a general consideration of the difficulties attendant upon such a study, and of the means by which these difficulties may be overcome.

Under the heading of Methods we describe a *cardiometer* which we employed to measure the contraction volume and the "output," as well as the changes in the volume of the heart other than those due to its rhythmic contractions and expansions. A description is also given of the method of employing it, together with a statement as to the degree of the accuracy with which, according to our experience, the instrument supplies information regarding the changes in the volume of the heart. We then describe an automatic counter, which we employed for measuring out and recording the output of the heart, as obtained by the cardiometer.

This is followed by a description of our *myocardiograph*, which we made use of to record the contractions and expansions of any part or parts of the ventricular and auricular walls without interfering with the movements of the heart. In most cases we employed this instrument to obtain simultaneous records of the contractions of one auricle and one ventricle. We state also our doubts as to the